

REMARKS

By this Amendment, Claims 1, 4, 5, 10 and 12 are amended, and new Claims 39-42 are added, leaving Claims 1-15 and 39-42 pending. Reconsideration of the August 19, 2003, final Official Action (hereinafter "the Official Action") is respectfully requested.

1. **Rejection of Claims 1-4, 6, 8 and 10-14 Under 35 U.S.C. §103(a)**

Claims 1-4, 6, 8 and 10-14 were rejected under 35 U.S.C. §103(a) over WO 00/41212 to Ni et al. ("Ni") in view of U.S. Patent No. 4,980,204 to Fujii et al. ("Fujii"). The reasons for the rejection are stated at pages 2-4 of the Official Action. Claim 12 has been amended to depend from independent Claim 7. The rejection is respectfully traversed.

The Official Action asserts that Ni discloses "the invention" substantially as claimed, including a gas injector 22, but acknowledges that Ni "fails to expressly disclose a gas injector including a plurality of gas outlets supplying gas at flow rates that are independently varied and wherein the gas outlets are supplied process gas by a single gas supply." The gas injector 22 shown in Fig. 3A of Ni mentioned in the Official Action includes a central bore 44 and gas outlets 46 in fluid communication with the central bore.

The Official Action asserts that Fujii discloses "a gas injector" having a plurality of "outlets" 111-114 connected to a single gas supply line and that independent flow rate control is provided by gas flow control valves 13-16.

The Official Action further asserts that it would have been obvious to modify the apparatus of Ni to include the gas injector structure of Fujii.

In the Advisory Action mailed October 8, 2003, it was asserted that:

[A]pplicant is interpreting the phrase distal end in the claim to mean a single gas injector that includes a plurality of gas outlets in a single distal end. This is an overly narrow meaning of the phrase in the claim because the specification does not define the phrase 'distal end' in this way and the word single never appears in the claim. Furthermore, one could interpret the claim so that multiple outlets represent a gas injector and only one of the outlets represent a distal end and claim 1 would still be properly rejected. (Emphasis added.)

Applicants respectfully disagree with these assertions in the Official Action and Advisory Action. Claim 1, as amended, recites a plasma processing system comprising, inter alia, “a gas injector ... comprising a body including an axial end surface exposed within the processing chamber, a side surface extending axially from the axial end surface, and a plurality of gas outlets including at least one on-axis outlet in the axial end surface and a plurality of spaced-apart off-axis outlets in the side surface; a common gas supply in fluid communication with a first gas line and a second gas line, the first gas line being in fluid communication with the on-axis outlet but not with the off-axis outlets and the second gas line being in fluid communication with the off-axis outlets but not with the on-axis outlet; [and] flow controllers operable to supply process gas from the common gas supply at flow rates that are independently varied between the on-axis outlet and the off-axis outlets into the processing chamber” (emphasis added). Support for the amendments to Claim 1 is provided, for example, in Figures 2a-2c of the present application. Ni and Fujii fail to suggest the plasma processing system recited in Claim 1 for the following reasons.

Ni does not suggest a gas injector including a plurality of gas outlets supplying gas at flow rates that are independently varied and supplied process gas by a common gas supply.

Fujii does not suggest a gas injector including “a plurality of gas outlets including at least one on-axis outlet in the axial end surface and a plurality of spaced-apart off-axis outlets in the side surface” (emphasis added), as recited in Claim 1. Fujii discloses multiple injectors, i.e., multiple vent pipes 111, 112, 113 and 114, each having one axial outlet. Fujii does not suggest that any of the vent pipes includes “off-axis outlets in the side surface,” as recited in Claim 1. Accordingly, because Fujii does not suggest the gas injector recited in Claim 1, even if the teachings of Ni and Fujii were combined, the combined teachings still would not result in a plasma processing system that includes every feature recited in Claim 1. As stated in MPEP §2143, in order to establish a prima facie case of obviousness, “the prior art reference (or references when combined) must teach or suggest all the claim limitations.” Thus, Ni and Fujii fail to support the alleged prima facie case of obviousness

regarding the subject matter recited in Claim 1. Therefore, Claim 1 is patentable over the combination of Ni and Fujii.

Claims 2-4, 6, 11 and 13 depend from Claim 1 and thus also are patentable over Ni and Fujii for at least the same reasons that Claim 1 is patentable.

Claim 10 has been amended to recite that the "distal end" including a plurality of gas outlets is a "single" distal end. Particularly, Claim 10 has been amended to recite a plasma processing system comprising, inter alia, "a gas injector extending through the dielectric member such that a single distal end of the gas injector is exposed within the processing chamber, the gas injector including a plurality of gas outlets in the single distal end supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber, the gas outlets being supplied process gas by a single gas supply" (emphasis added).

Regarding the assertion in the Advisory Action that "one could interpret the claim so that multiple outlets represent a gas injector and only one of the outlets represent a distal end" (emphasis added), Claim 10 recites a "gas injector including a plurality of gas outlets in the single distal end." Accordingly, Claim 10 requires a single distal end including a plurality of gas outlets. As such, if one of the outlets of the claimed gas injector is interpreted to represent "a distal end" as mentioned in the Advisory Action, that distal end would necessarily include only one outlet, but not a plurality of gas outlets, as recited in Claim 10. Thus, the interpretation of Claim 10 asserted in the Advisory Action is clearly inconsistent with the plain meaning of this claim.

Fuji does not suggest a gas injector that has a single distal end, wherein that gas injector includes a plurality of gas outlets in the single distal end. Rather, Fujii's separate vent pipes 111, 112, 113 and 114 each have one associated distal end and one outlet. The separate vent pipes 111, 112, 113 and 114 are not provided in a single distal end of a gas injector. Accordingly, because Fujii does not disclose or suggest the gas injector recited in Claim 10, even if the teachings of Ni and Fujii were combined, the combined teachings still

would not result in a plasma processing system that includes every feature recited in Claim 10, including the feature of “a gas injector extending through the dielectric member such that a single distal end of the gas injector is exposed within the processing chamber, the gas injector including a plurality of gas outlets in the single distal end supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber, the gas outlets being supplied process gas by a single gas supply” (emphasis added). Thus, Ni and Fujii fail to support the alleged prima facie case of obviousness regarding the subject matter recited in Claim 10, which therefore is patentable.

Withdrawal of the rejection is respectfully requested.

2. Rejection of Claims 5, 7 and 9 Under 35 U.S.C. §103(a)

Claims 5, 7 and 9 were rejected under 35 U.S.C. §103(a) over Ni and Fujii and further in view of U.S. Patent No. 5,160,543 to Ishihara et al. ("Ishihara"). The reasons for the rejection are stated at pages 4-5 of the Official Action. The rejection is respectfully traversed.

Claim 5 depends from Claim 1. Ishihara fails to cure the deficiencies of Ni and Fujii regarding the subject matter recited in Claim 1. Ishihara discloses an apparatus that includes gas introducing pipes 209, 210, which introduce gas via the same gas introducing port 211. The gas introducing pipes 209 and 210 are supplied gas from separate gas supplies via gas feeding pipelines 223, 224, respectively, as shown in FIG. 2 of Ishihara. Accordingly, Ishihara provides no motivation to modify Ni to include a “gas injector comprising a body including an axial end surface exposed within the processing chamber, a side surface extending axially from the axial end surface, and a plurality of gas outlets including at least one on-axis outlet in the axial end surface and a plurality of spaced-apart off-axis outlets in the side surface”; “a common gas supply in fluid communication with a first gas line and a second gas line, the first gas line being in fluid communication with the on-axis outlet but not with the off-axis outlets and the second gas line being in fluid

communication with the off-axis outlets but not with the on-axis outlet"; and flow controllers operable to supply process gas from the common gas supply at flow rates that are independently varied between the on-axis outlet and the off-axis outlets into the processing chamber," as recited in Claim 1. Thus, the plasma processing system recited in Claim 5 also is patentable over the combination of Ni, Fujii and Ishihara for at least the same reasons that Claim 1 is patentable.

Independent Claim 7 recites a plasma processing system, which comprises, inter alia, "a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the gas injector including a planar axial end face having an on-axis outlet therein and a conical side surface having off-axis outlets therein, the on-axis outlet receiving process gas from a central passage in the injector and the off-axis outlets receiving process gas from an annular passage surrounding the central passage, the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets including the on-axis outlet into the processing chamber (emphasis added). Ni, Fujii and Ishihara fail to suggest the plasma processing system recited in Claim 7 for the following reasons.

The Official Action acknowledges that Ni fails to disclose or suggest a gas injector "including a plurality of gas outlets supplying gas at flow rates that are independently varied and wherein the gas outlets are supplied process gas by a single gas supply." Furthermore, Ni does not disclose a conical surface having off-axis outlets therein, as recited in Claim 7. Ni also does not disclose "off-axis outlets receiving process gas from an annular passage surrounding the central passage," as recited in Claim 7.

Fujii fails to cure the deficiencies of Ni regarding the plasma processing system recited in Claim 7. Fujii does not suggest the feature of "the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets including the on-axis outlet into the processing chamber," as recited in Claim 7.

Ishihara fails to cure the deficiencies of Ni and Fujii with respect to the plasma processing system recited in Claim 7. Ishihara fails to disclose a gas injector having a conical side surface having off-axis outlets therein. The gas introducing port 211 of Ishihara "constitutes the tip portions of the gas introducing pipes [209, 210]" and not a conical side surface having off-axis outlets therein (column 5, lines 54-63). The gas introducing port 211 of Ishihara is located in an axial end surface, not in a conical side surface, as recited in Claim 7. Furthermore, Ishihara does not suggest the feature of "the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets including the on-axis outlet into the processing chamber," as recited in Claim 7. Accordingly, because the combination of Ni, Fujii and Ishihara does not suggest the combination of features recited in Claim 7, Claim 7 also is patentable.

Independent Claim 9 recites a plasma processing system, which comprises, inter alia, "a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the gas injector including at least one on-axis outlet which injects process gas in an axial direction perpendicular to a plane parallel to an exposed surface of the substrate and off-axis gas outlets which inject process gas at an acute angle relative to the plane parallel to the exposed surface of the substrate, the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber" (emphasis added). Ni, Fujii and Ishihara fail to suggest the plasma processing system recited in Claim 9 for the following reasons.

Ni fails to suggest a gas injector including at least one on-axis outlet and off-axis outlets that supply process gas at flow rates that are independently controlled.

Fujii and Ishihara fail to cure the deficiencies of Ni regarding the plasma processing system recited in Claim 9. Fujii does not disclose or suggest the feature of "off-axis gas outlets which inject process gas at an acute angle relative to the plane parallel to the exposed surface of the substrate," as recited in Claim 9. Ishihara's gas introducing port 211 forms the tip portions of the gas introducing pipes 209 and 210. Ishihara fails to disclose a

plurality of "angled" outlets in an injector. Moreover, Ishihara's gas introducing pipe 210 will deliver gas primarily along the central axis of the means for gas introduction. Ishihara does not suggest that the gas introducing pipe injects process gas at an acute angle relative to a plane parallel to an exposed surface of substrate 218 depicted in FIG. 2.

Also, the combination of Ni, Fujii and Ishihara fails to suggest the feature recited in Claim 9 that the "gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets." As such, the combination of Ni, Fujii and Ishihara cannot suggest the combination of features recited in Claim 9, which includes "at least one on-axis outlet ... and off-axis outlets ... the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber." Thus, the subject matter recited in Claim 9 also is patentable.

Therefore, withdrawal of the rejection is respectfully requested.

3. Rejection of Claim 15 Under 35 U.S.C. §103(a)

Claim 15 was rejected under 35 U.S.C. §103(a) over Ni in view of Fujii and further in view of U.S. Patent No. 6,287,643 to Powell et al. ("Powell"). The reasons for the rejection are stated at page 5 of the Official Action. The rejection is respectfully traversed.

Powell was cited in the Official Action for the disclosure of a gas injection tube 84 provided with an electrically conductive shield. Powell discloses a remote plasma source 70 comprising an outer tube 72 used for plasma confinement and excitation, and an inner coaxial tube 84 used for importing gas to the chamber (column 8, lines 13-18). An external RF coil 78 is wound about the plasma confinement tube 72 (column 8, lines 37-38). Ni discloses a gas injector centrally mounted in a plasma etch reactor and confining a plasma in an area above the substrate (Ni at page 9, lines 8-22). Ni does not, however, provide the motivation to avoid plasma generation within the injector. The Official Action has not provided the required motivation to combine Powell with Ni and Fujii in a manner that would produce the claimed system. Furthermore, even if Powell were combined with the injector of

Ni, the resulting combination still fails to produce the plasma processing system recited in Claim 1, from which Claim 15 depends. Accordingly, the combination of features recited in Claim 15 is patentable over Ni, Fujii and Powell. Therefore, withdrawal of the rejection is respectfully requested.

4. Second Rejection of Claims 1-4, 6, 8 and 10-14 Under 35 U.S.C. §103(a)

Claims 1-4, 6, 8 and 10-14 were rejected under 35 U.S.C. § 103(a) over Ni in view of Fujii in further view of U.S. Patent No. 4,105,810 to Yamazaki et al. ("Yamazaki"). The reasons for the rejection are stated at pages 5-7 of the Official Action. The rejection is respectfully traversed.

The deficiencies of Ni and Fujii with respect to the combinations of features recited in Claims 1 and 10 are discussed above.

Yamazaki fails to cure the deficiencies of Ni and Fujii. The Official Action asserts that Yamazaki discloses an apparatus comprising a gas injector having a plurality of gas outlets that are independently connected to a single gas supply line. Yamazaki discloses an apparatus having an oxygen source 1 and a carrier gas source 2 (column 6, lines 47-57 and Figure 1). The carrier gas is used to transport raw materials to a reactor (column 6, lines 47-57 and Figure 1). Yamazaki fails to suggest the features of "the gas injector comprising a body including an axial end surface exposed within the processing chamber, a side surface extending axially from the axial end surface, and a plurality of gas outlets including at least one on-axis outlet in the axial end surface and a plurality of spaced-apart off-axis outlets in the side surface," as recited in Claim 1. It is respectfully submitted that Fujii and Yamazaki fail to provide the required motivation to modify Ni to achieve the subject matter recited in Claim 1.

Regarding Claim 10, Yamazaki fails to disclose or suggest the claimed features of "a gas injector extending through the dielectric member such that a single distal end of the gas injector is exposed within the processing chamber, the gas injector including a plurality of

gas outlets in the single distal end supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber, the gas outlets being supplied process gas by a single gas supply” (emphasis added).

Accordingly, Ni, Fujii and Yamazaki fail to suggest the combinations of features recited in Claims 1 and 10, as well as in dependent Claims 2-4, 6, 8 and 11, 13 and 14. Therefore, withdrawal of the rejection is respectfully requested.

5. Second Rejection of Claim 15 Under 35 U.S.C. §103(a)

Claim 15 was rejected under 35 U.S.C. §103(a) over Ni in view of Yamazaki and Fujii and further in view of Powell. The reasons for the rejection are stated at page 8 of the Official Action. The rejection is respectfully traversed.

As explained above, Powell fails to cure the deficiencies of Ni and Fujii with respect to the plasma processing system recited in Claim 1, from which Claim 15 depends. Accordingly, the combination of features recited in Claim 15 is patentable over Ni, Yamazaki, Fujii and Powell.

Therefore, withdrawal of the rejection is respectfully requested.

6. Rejection of Claims 1-14 Under 35 U.S.C. §103(a)

Claims 1-14 were rejected under 35 U.S.C. § 103(a) over Ni in view of Ishihara and Fujii. The reasons for the rejection are stated at pages 8-10 of the Official Action. The rejection is respectfully traversed.

As discussed above, the combination of Ni, Ishihara and Fujii was also applied against Claims 5, 7 and 9. Ishihara fails to cure the deficiencies of Ni and Fujii as applied to Claims 5, 7 and 9.

For reasons stated above, Ishihara and Fujii fail to suggest modifying Ni to achieve the combination of features recited in Claim 1, including the features of “the gas injector comprising a body including an axial end surface exposed within the processing chamber, a side surface extending axially from the axial end surface, and a plurality of gas outlets

including at least one on-axis outlet in the axial end surface and a plurality of spaced-apart off-axis outlets in the side surface”; “a common gas supply in fluid communication with a first gas line and a second gas line, the first gas line being in fluid communication with the on-axis outlet but not with the off-axis outlets and the second gas line being in fluid communication with the off-axis outlets but not with the on-axis outlet”; [and] “flow controllers operable to supply process gas from the common gas supply at flow rates that are independently varied between the on-axis outlet and the off-axis outlets into the processing chamber.”

Neither Ni, Ishihara nor Fuji suggests the features of “a gas injector extending through the dielectric member such that a single distal end of the gas injector is exposed within the processing chamber, the gas injector including a plurality of gas outlets in the single distal end supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber, the gas outlets being supplied process gas by a single gas supply” (emphasis added), as recited in Claim 10.

Accordingly, Claims 1 and 10 are patentable over the combination of Ni, Ishihara and Fujii. Dependent Claims 2-6, 8, 11, 13 and 14 also are patentable over the cited combination of references for at least the same reasons that Claim 1 is patentable.

Withdrawal of the rejection is respectfully requested.

7. Third Rejection of Claim 15 Under 35 U.S.C. §103(a)

Claim 15 was rejected under 35 U.S.C. § 103(a) over Ni in view of Ishihara and Fujii and further in view of Powell. The reasons for the rejection are stated at page 11 of the Official Action. The rejection is respectfully traversed.

As explained above, impermissible hindsight is needed to provide the necessary incentive to selectively add the conductive shield of Powell to the injector of Ni. The combination of features recited in Claim 15 is thus patentable over Ni, Ishihara, Fujii and Powell. Therefore, withdrawal of the rejection is respectfully requested.

8. New Claims

New dependent Claims 39 and 40 depend from Claims 1 and 10, respectively, and recite that "the plurality of gas outlets in the single distal end of the gas injector are oriented at different angles relative to an exposed surface of the substrate." For example, Figure 2a of the present application shows an embodiment of the gas injector 22 including a single distal end and outlets 24 and 26 in the single distal end, which are oriented at different angles relative to an exposed surface of a substrate, such as substrate 13 depicted in Figure 3c. The combinations of features recited in Claims 39 and 40 are also patentable for at least the same reasons that Claims 1 and 10 are patentable.

New independent Claim 41 is directed to a plasma processing system comprising, inter alia, "a gas injector body extending through the dielectric member such that a distal end of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of gas outlets" and "means for supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber." The subject matter of Claim 41 is believed to be patentable.

Lastly, independent Claim 42 is directed to a plasma processing system comprising, inter alia, "a gas injector comprising an injector body including at least first and second gas inlets, at least first and second gas passages, and at least first and second gas outlets, the first gas passage being in fluid communication with the first inlet and first outlet, and the second gas passage being in fluid communication with the second inlet and second outlet, the first and second gas passages not being in fluid communication with each other; [and] flow controllers providing independently adjustable flow rates of gas through the first and second outlets." Support for the gas injector recited in Claim 42 is provided in original Claim 35. The subject matter recited in Claim 42 also is believed to be patentable.

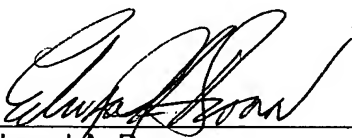
9. **Conclusion**

For the foregoing reasons, it is respectfully submitted that the present application is in condition for allowance and such action is earnestly solicited.

Respectfully submitted,

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